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Magsat anomaly map and continental drift

by

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MAGSAT ANOMALY MAP AND CONTINENTAL DRIFT

by

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OBJECTIVE :

MAGSAT has been specifically designed to give high precision measurements of the geomagnetic field. When properly reduced from the time variations, these measurements should yield, after subtracting the main field, anomaly maps of high quality. This high quality is needed in particular to display unambiguously the so called long-wave length anomalies. In this report we analyse the anomalies in terms of continental drift and we try to give some hints on the nature of their sources.

BACKGROUND :

The models presented in our last progress report ("preliminary models of the core field") were found unsatisfactory to give precise anomaly maps, this was probably due to problems in the reduction of the time variations of external origin. Then we used the model of Langel et al (1981) and the corresponding anomaly maps for our preliminary interpretation, the results of which are to be found in Galdeano (1981).

RECENT ACCOMPLISHMENTS :

a) general features of the intensity anomaly map.

The differences with the maps yielded by ground measurements is very striking. The intense anomalies linked with the oceanic crust vanish almost completely in Langel's map. This confirms the thinness of the oceanic magnetized layer. The only area when the anomalies are rather intense is the North-West Pacific and this is a region of low heat flow. Over continental domains the average anomalies of Langel's map are larger. Besides the most intense anomalies are strongly linked to the oldest cratons and to their close vicinity where low heat flow values are found (Chapman and Pollack, 1977). It must be noted also that these continental magnetic anomalies are characterised by elongated structures generally of East-West trend.

b) paleomagnetic reconstruction.

The link between the intense magnetic anomalies and the old cratons leads naturally to compare the western Africa and the Brazilian South America. When the South Atlantic ocean is closed as shown on the figure 1 the agreement between the anomalies is as good as possible : positive and negative regions are in the right place and East-West continuity is perfect. As for the north Atlantic the best model is found to be the one by Sclater et al (1977). We add to this model the other pieces of the Gondwana continent (Indian peninsula, Australia, Antarctic). The precision of the fit of the magnetic anomalies is lower because these pieces experienced large motions along meridians, and there is certainly a bias when the reduction of magnetization inclination is not performed. Nevertheless the anomalies found in India, Australia and Antarctic exhibit a fair consistency with the African anomalies.

c) source magnetization.

Preliminary studies of the direction of the magnetization show in most cases (in particular for the Bangui anomaly) a direction not far from the direction of the present field. If, as shown by the quality of the fit, the anomalies are locked under the continents and have a fixed geometry, then the magnetization is mainly induced, and precludes any remanent mechanism.

Haggerty (1978) showed that some Fe-Ni, Fe-Co and Cu-Co combinations may have Curie points larger than 1100°C. This kind of compound could exist in plutonic series, and could be stable down to the crust mantle interface where we suggest to localize the origin of the long wave length anomalies.

FUTURE EMPHASIS

We are working in two directions. Firstly we still have to explain the geographic distribution of the anomalies (this may be caused by a geographic zonation of the chemical elements responsible of the magnetization) and the fact that part of the anomalies are under oceanic areas (this can be interpreted by a decoupling between the magnetic sources level and the upper part of the crust during the continental drift). Secondly we are trying to improve, if possible, Langel's map and for that

we are preparing new models of the main field these models are to be presented in our next progress report.

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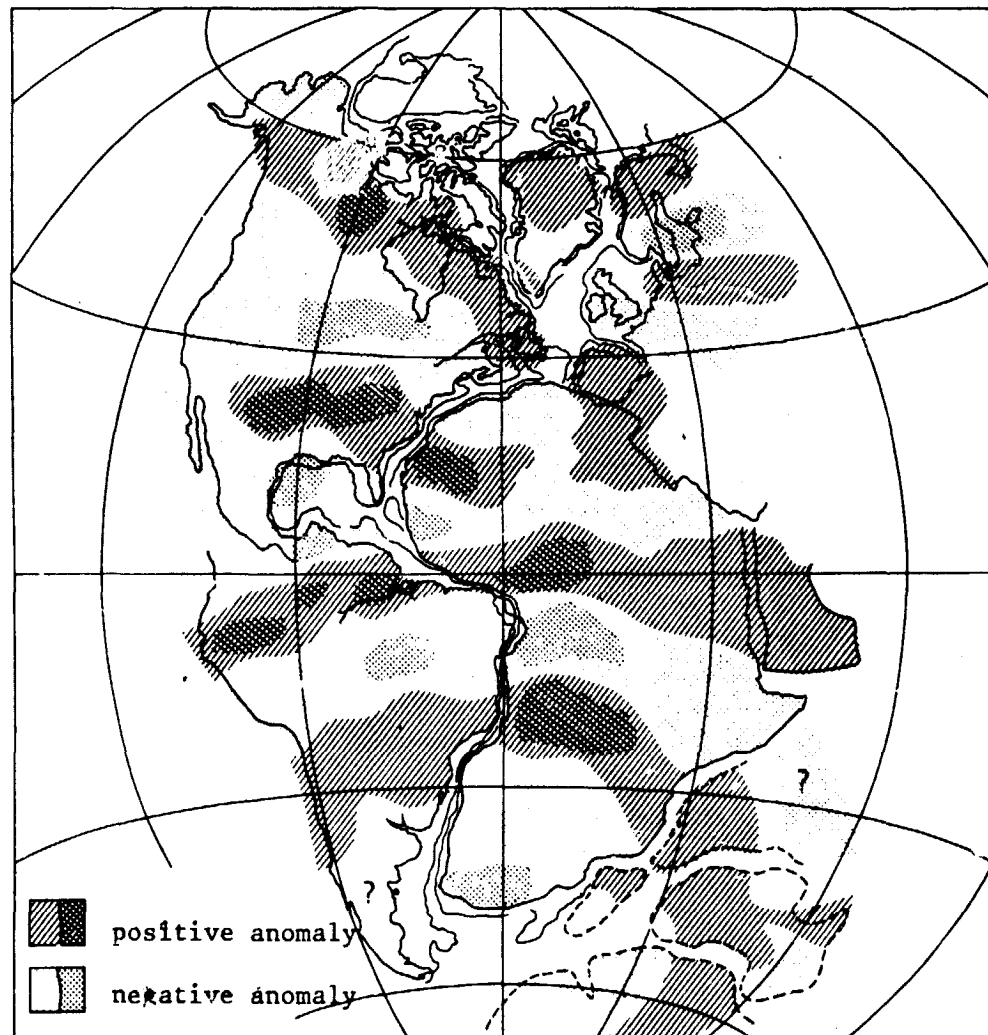


Figure 1 : Distribution of the positive and negative anomalies over the continents the position of which is given before the opening of the atlantic ocean.